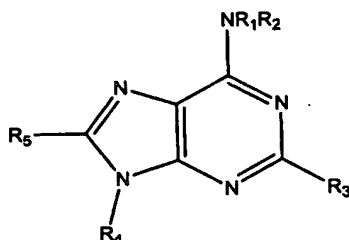


## CLAIMS

What is claimed is:

1. A pharmaceutical composition comprising a pharmaceutically acceptable carrier in combination with a compound having cytokinin activity in a dosage form effective to modulate glucose metabolism in a mammal when the composition is administered to the mammal at a concentration effective to modulate glucose metabolism, and wherein the compound is not metformin.
2. The pharmaceutical composition of claim 1 wherein the compound having cytokinin activity comprises a purine scaffold.
3. The pharmaceutical composition of claim 2 wherein the compound having cytokinin activity has a structure according to Formula I:



Formula I

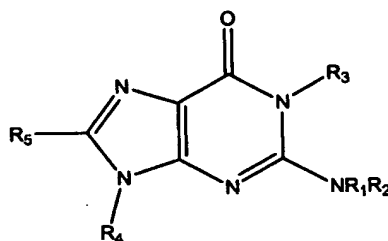
wherein  $R_1$  and  $R_2$  are independently H, optionally substituted alkyl, optionally substituted alkenyl, optionally substituted alkynyl, optionally substituted aryl, optionally substituted alkaryl, optionally substituted heteroaryl, optionally substituted heteroalkaryl, optionally substituted heterocycle, OH, NOH, CN,  $NR_3R_4$ ,  $NHCOR$ ,  $NHCONH_2$ ,  $NHCSNH_2$ ,  $OCH_2COOH$ ,  $OCH_2CONH_2$ ,  $OCH_2CONHR$ ,  $OC(CH_3)_2COOH$ ,  $OC(CH_3)_2CONH_2$ ,  $NHCH_2COOH$ ,  $NHCH_2CONH_2$ ,  $NHSO_2R$ ,  $NHSO_2CF_3$ ,  $OCH_2$ -heterocycle,  $PO_3H$ ,  $SO_3H$ ,  $(CH_2)_{1-3}COOH$ ,  $CH=CHCOOH$ ,  $O(CH_2)_{1-4}COOH$ ,  $NHCOCH_2CH(OH)COOH$ ,  $CH(COOH)_2$ ,  $CH(PO_3H)_2$ ,  $NHCHO$ ,  $OCH_2CH_2CH_2COOH$ ;

wherein R is independently  $R_1$ , and with the proviso that  $R_1$  and  $R_2$  in  $NR_1R_2$  are not H at the same time; and

wherein  $R_3$ ,  $R_4$ , and  $R_5$  are independently H, optionally substituted alkyl, optionally substituted alkenyl, optionally substituted alkynyl, optionally substituted aryl,

optionally substituted alkaryl, optionally substituted heteroaryl, optionally substituted heteroalkaryl, optionally substituted heterocycle,  $\text{NH}_2$ , OH, NOH, CN,  $\text{CF}_3$ , O-alkyl, S-alkyl, NH-alkyl, carbohydrate radical, carbocyclic radical, or carbohydrate analog radical.

4. The pharmaceutical composition of claim 3 wherein  $\text{R}_1$ ,  $\text{R}_3$ , and  $\text{R}_5$  are H.
5. The pharmaceutical composition of claim 2 wherein the compound is present as a pharmaceutically acceptable salt, a hydrate, or in form of a prodrug.
6. The pharmaceutical composition of claim 2 wherein the compound having cytokinin activity has a structure according to Formula II:



*Formula II*

wherein  $\text{R}_1$  and  $\text{R}_2$  are independently H, optionally substituted alkyl, optionally substituted alkenyl, optionally substituted alkynyl, optionally substituted aryl, optionally substituted alkaryl, optionally substituted heteroaryl, optionally substituted heteroalkaryl, optionally substituted heterocycle, OH, NOH, CN,  $\text{NR}_3\text{R}_4$ ,  $\text{NHCOR}$ ,  $\text{NHCONH}_2$ ,  $\text{NHCSNH}_2$ ,  $\text{OCH}_2\text{COOH}$ ,  $\text{OCH}_2\text{CONH}_2$ ,  $\text{OCH}_2\text{CONHR}$ ,  $\text{OC}(\text{CH}_3)_2\text{COOH}$ ,  $\text{OC}(\text{CH}_3)_2\text{CONH}_2$ ,  $\text{NHCH}_2\text{COOH}$ ,  $\text{NHCH}_2\text{CONH}_2$ ,  $\text{NHSO}_2\text{R}$ ,  $\text{NHSO}_2\text{CF}_3$ ,  $\text{OCH}_2$ -heterocycle,  $\text{PO}_3\text{H}$ ,  $\text{SO}_3\text{H}$ ,  $(\text{CH}_2)_{1-3}\text{COOH}$ ,  $\text{CH}=\text{CHCOOH}$ ,  $\text{O}(\text{CH}_2)_{1-4}\text{COOH}$ ,  $\text{NHCOCH}_2\text{CH}(\text{OH})\text{COOH}$ ,  $\text{CH}(\text{COOH})_2$ ,  $\text{CH}(\text{PO}_3\text{H})_2$ ,  $\text{NHCHO}$ ,  $\text{OCH}_2\text{CH}_2\text{CH}_2\text{COOH}$ ;

wherein R is independently  $\text{R}_1$ , and with the proviso that  $\text{R}_1$  and  $\text{R}_2$  in  $\text{NR}_1\text{R}_2$  are not H at the same time; and

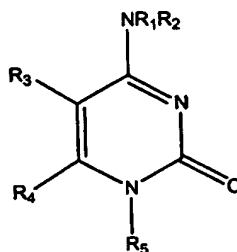
wherein  $\text{R}_3$ ,  $\text{R}_4$ , and  $\text{R}_5$  are independently H, optionally substituted alkyl, optionally substituted alkenyl, optionally substituted alkynyl, optionally substituted aryl, optionally substituted alkaryl, optionally substituted heteroaryl, optionally substituted heteroalkaryl, optionally substituted heterocycle,  $\text{NH}_2$ , OH, NOH,

CN, CF<sub>3</sub>, O-alkyl, S-alkyl, NH-alkyl, carbohydrate radical, carbocyclic radical, or carbohydrate analog radical.

7. The pharmaceutical composition of claim 6, wherein R<sub>1</sub>, R<sub>3</sub>, and R<sub>5</sub> are H.
8. The pharmaceutical composition of claim 6 wherein the compound is present as a pharmaceutically acceptable salt, a hydrate, or in form of a prodrug.
9. The pharmaceutical composition of claim 2 wherein the compound having cytokinin activity is selected from the group consisting of N6-benzyladenine, N6-benzyladenine hydrochloride, N6-benzyladenosine, N6-benzyladenine-3-glucoside, N6-benzyladenine-7-glucoside, N6-benzyladenine-9-glucoside, N6-benzyl-9-(2-tetrahydropyranyl)adenine, N6-benzyladenosine-5'-monophosphate, dihydrozeatin, dihydrozeatin riboside, dihydrozeatin-7-β-D-glucoside, dihydrozeatin-9-β-D-glucoside, dihydrozeatin-O-glucoside, dihydrozeatin-O-glucoside riboside, dihydrozeatin riboside-5'-monophosphate, dihydrozeatin-O-acetyl, N6-isopentenyladenine, N6-isopentenyladenosine, N6-isopentenyladenosine-5'-monophosphate, N6-isopentenyladenine-7-glucoside, N6-isopentenyladenine-9-glucoside, 2-methylthio-N6-isopentenyladenosine, 2-methylthio-N6-isopentenyladenine, 2-thio-N6-isopentenyladenine, 2-benzylthio-N6-isopentenyladenine, kinetin, kinetin riboside, kinetin-9-glucoside, kinetin riboside-5'-monophosphate, meta-topolin, meta-topolin riboside, meta-topolin-9-glucoside, ortho-topolin, ortho-topolin riboside, ortho-topolin-9-glucoside, trans-zeatin, trans-zeatin riboside, cis-zeatin, cis-zeatin riboside, trans-zeatin-7-glucoside, trans-zeatin-9-glucoside, trans-zeatin-O-glucoside, trans-zeatin-O-glucoside riboside, trans-zeatin riboside-5'-monophosphate, trans-zeatin-O-acetyl, 2-chloro-trans-zeatin, N2-acyl-guanine, N2-acyl-guanosine, 2-methylthio-trans-zeatin, and 2-methylthio-trans-zeatin riboside.
10. The pharmaceutical composition of claim 9 wherein the compound is present as a pharmaceutically acceptable salt, a hydrate, or in form of a prodrug.
11. The pharmaceutical composition of claim 2 wherein the compound having cytokinin activity is selected from the group consisting of N2-acetylguanine, N6-

benzyladenine, dihydrozeatin, cis-zeatin, trans-zeatin, N6-isopentenyladenine, kinetin, and meta-topolin.

12. The pharmaceutical composition of claim 11 wherein the compound is present as a pharmaceutically acceptable salt, a hydrate, or in form of a prodrug.
13. The pharmaceutical composition of claim 2 wherein the compound having cytokinin activity is selected from the group consisting of N2-acetylguanosine, N6-benzyladenosine, dihydrozeatin riboside, cis-zeatin riboside, trans-zeatin riboside, N6-isopentenyladenosine, kinetin riboside, and meta-topolin riboside.
14. The pharmaceutical composition of claim 13 wherein the compound is present as a pharmaceutically acceptable salt, a hydrate, or in form of a prodrug.
15. The pharmaceutical composition of claim 1 wherein the compound having cytokinin activity comprises a pyrimidine scaffold.
16. The pharmaceutical composition of claim 15 wherein the compound having cytokinin activity has a structure according to Formula III:



*Formula III*

wherein  $R_1$  and  $R_2$  are independently H, optionally substituted alkyl, optionally substituted alkenyl, optionally substituted alkynyl, optionally substituted aryl, optionally substituted alkaryl, optionally substituted heteroaryl, optionally substituted heteroalkaryl, optionally substituted heterocycle, OH, NOH, CN,  $NR_3R_4$ ,  $NHCOR$ ,  $NHCONH_2$ ,  $NHCSNH_2$ ,  $OCH_2COOH$ ,  $OCH_2CONH_2$ ,  $OCH_2CONHR$ ,  $OC(CH_3)_2COOH$ ,  $OC(CH_3)_2CONH_2$ ,  $NHCH_2COOH$ ,  $NHCH_2CONH_2$ ,  $NHSO_2R$ ,  $NHSO_2CF_3$ ,  $OCH_2$ -heterocycle,  $PO_3H$ ,  $SO_3H$ ,  $(CH_2)_{1-3}COOH$ ,  $CH=CHCOOH$ ,  $O(CH_2)_{1-4}COOH$ ,  $NHCOCH_2CH(OH)COOH$ ,  $CH(COOH)_2$ ,  $CH(PO_3H)_2$ ,  $NHCHO$ ,  $OCH_2CH_2CH_2COOH$ ;

wherein R is independently R<sub>1</sub>, and with the proviso that R<sub>1</sub> and R<sub>2</sub> in NR<sub>1</sub>R<sub>2</sub> are not H at the same time; and

wherein R<sub>3</sub>, R<sub>4</sub>, and R<sub>5</sub> are independently H, optionally substituted alkyl, optionally substituted alkenyl, optionally substituted alkynyl, optionally substituted aryl, optionally substituted alkaryl, optionally substituted heteroaryl, optionally substituted heteroalkaryl, optionally substituted heterocycle, NH<sub>2</sub>, OH, NOH, CN, CF<sub>3</sub>, O-alkyl, S-alkyl, NH-alkyl, carbohydrate radical, carbocyclic radical, or carbohydrate analog radical.

17. The pharmaceutical composition of claim 16 wherein R<sub>1</sub>, R<sub>3</sub>, and R<sub>4</sub> are H, and wherein R<sub>2</sub> is acyl.
18. The pharmaceutical composition of any one of claims 3, 6, or 16, further comprising a second compound selected from the group consisting of a biguanide, a sulfonyl urea, a meglitinide, a thiazolidinedione, and a second compound having cytokinin activity.
19. A method of modulating glucose metabolism in a mammal comprising a step of administering a compound according to claim 1 at a dosage effective to modulate glucose metabolism in the mammal.
20. A method of modulating glucose metabolism in a mammal comprising a step of administering a compound according to any one of claims 3, 6, or 16 at a dosage effective to modulate glucose metabolism in the mammal.
21. The method of claim 20 wherein the mammal is diagnosed with at least one of syndrome X, pre-diabetes, insulin resistance, type-2 diabetes, and dyslipidemia.
22. The method of claim 20 wherein the administration is prophylactic administration to prevent at least one of Syndrome X, pre-diabetes, insulin resistance, type-2 diabetes, and dyslipidemia.
23. The method of claim 20 wherein modulating glucose metabolism in a mammal comprises increasing glucose uptake in a muscle cell.

24. The method of claim 20 wherein modulating glucose metabolism in a mammal comprises decreasing gluconeogenesis in a hepatocyte.
25. A method of modulating lipid metabolism in a mammal comprising a step of administering a compound according to claim 1 at a dosage effective to modulate glucose metabolism in the mammal, and wherein the compound is not a N6-aralkyladenosine.
26. A method of modulating lipid metabolism in a mammal comprising a step of administering a compound according to any one of claims 3, 6, or 16 at a dosage effective to modulate glucose metabolism in the mammal, and wherein the compound is not a N6-aralkyladenosine.
27. The method of claim 26 wherein the mammal is diagnosed with at least one of Syndrome X and dyslipidemia.
28. The method of claim 26 wherein the administration is prophylactic administration to prevent at least one of Syndrome X and dyslipidemia.
29. The method of claim 26 wherein modulating lipid metabolism in a mammal comprises at least one of decreasing total serum cholesterol, decreasing serum LDL-cholesterol, and decreasing serum triglycerides.
30. A method of treating a condition in a mammal associated with dysregulation of at least one of AMPK and Akt comprising a step of administering a compound according to claim 1 at a dosage effective to activate at least one of AMPK and Akt.
31. The method of claim 21 wherein the condition is selected from the group consisting of a cardiovascular disease, type 2 diabetes, and a neoplastic disease.
32. A method of performing an analytic test in a mammal comprising:  
determining a concentration of a compound according to any one of claim 1, 3, 6, or 16 in a biological fluid; and  
correlating the concentration with at least one of a likelihood and presence of a metabolic disorder, wherein the disorder is selected from the group consisting

of pre-diabetes, insulin resistance, type-2 diabetes, syndrome X, and dyslipidemia.

33. The method of claim 32 wherein a decrease in the concentration of the compound is associated with the likelihood or presence of the metabolic disorder.